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A MUNICIPAL WATERWORKS CONSTRUCTED AND OPERATED SOLELY FOR INDUSTRIAL SERVICE[1]

By Claude L. James

Mattoon, Illinois, has the distinction of owning and operating a system of waterworks solely for commercial purposes. The water for domestic uses and fire protection is furnished by a private corporation, the supply being taken from the glacial drift at a depth of about 60 feet. For purity and wholesomeness the water furnished by the private corporation is seldom excelled. The quantity obtainable from this source, however, was found to be insufficient to supply the domestic and commercial needs of the city. In order to have enough water to supply all demands of the railroads and other large consumers, the citizens of Mattoon organized early in 1907 a stock company to construct a waterworks system of sufficient capacity to meet all demands made by the large consumers. The capital stock of $105,000 was fully subscribed by the citizens of Mattoon after a canvass of less than ten days. Before the work of construction was begun, the city entered into a contract with the Mattoon Reservoir Company, agreeing to purchase the system after its completion and the company agreed to sell the plant to the city at the actual cost of construction plus 5 per cent interest. This agreement was carried out, and the city finished paying for the plant in four years time.

After the plant was fully completed a certified bill of cost was made setting out in detail the exact cost of the entire system including all dams, reservoirs, lands, engineering and supervision of construction. The total cost, including the lands, was $103,000. This amount completed the dams, reservoirs, pumping machinery, two pumping stations, suction pipe, intakes and about 5 miles of force mains between the pumping stations.

The Paradise reservoir was formed by throwing a dam across the Little Wabash valley at a point about 6 miles southwest of Mattoon. This dam is an earthen embankment about 400 feet in length, with a top width of 10 feet and a slope on the water side of 3 to 1 and one of 2 to 1 on the down-stream side.

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[1] Read before the Illinois Section at Urbana on March 14, 1917.

The concrete spillway is a structure 100 feet in width between abutments and was originally 20 feet in height above the stream bed. It was provided with a concrete apron 70 by 100 feet. A concrete heel was constructed 25 feet wide, and on this heel was placed a well compacted earth fill to an elevation within 7 feet of the crest of the spillway. The earth dam was built without a concrete core wall. A gravelly clay found near the site of the dam was used as a core wall. A core of this material about 6 feet in thickness was placed along the center line of the dam to an elevation of about 4 feet above the crest of the spillway. Special care was taken in compacting this clay while it was being placed. As it was impossible to use a roller on this part of the embankment, owing to the tendency of the clay to pick up, the material was compacted by driving horses back and forth as it was being placed. The dam has been free from seepage since it was placed in service. The concrete spillway was founded on very unstable soil; no rock, hardpan or other stable material could be located near the dam site. To overcome this condition Prof. A. N. Talbot gave the design of the dam much careful consideration and finally decided upon what might be called a spread foundation. The structure covered an overall area of 105 by 112 feet. The total cost of the earth dam and concrete spillway was $16,000.

The pipe line between the reservoir pumping station and the main pumping station consists of 12,000 feet of 12-inch cast iron pipe and about 13,000 feet of 18-inch vitrified clay sewer pipe. The water is pumped from Paradise reservoir through the cast iron pipe to the top of Magnet Hill, which has an elevation of 75 feet above the reservoir pumping station and 55 feet above the main pumping station. On account of this fact, together with the fact that the price of cast iron pipe in 1907 was $34 per ton, it was decided by the engineers in charge of the design to use vitrified clay sewer pipe as a gravity conduit from Magnet hill to the main pumping station. The sewer pipe used was the deep-and-wide socket type; the joints were made of jute and 1 to 1 Portland cement mortar. One-half of the joints were made on the bank of the ditch several days prior to the time of laying the pipe in the trench. This pipe was subjected to tests in sections of 1000 feet to determine the amount of leakage. These tests proved very satisfactory, as the leakage was very small.

The water supply is obtained from two distinct water sheds. The Kickapoo area in which the main pumping station is located is composed of about 4000 acres of farm land and is drained by 50 miles or more of drain tile ranging in size from 4 to 30 inches in diameter. The flow from these drains is intercepted by a line of sewer pipe laid by the water company, which conveys the water so intercepted to the service reservoir located at the main pumping station. The Little Wabash water shed above the dam comprises an area of 20 square miles. The surface of the ground in this district is of a fairly uniform slope of about 7 feet to the mile.

The service reservoir is 95 feet in diameter and 30 feet in depth, having a capacity of 1,500,000 gallons and cost $8200, including excavation. Since the beginning of the operation of the plant in the spring of 1908 the Kickapoo area has furnished about 60 per cent of the total amount of water pumped into the distribution system.

The Paradise impounding reservoir had an original capacity of 200,000,000 gallons but the droughts of 1913–14 lowered the water in the reservoir to such an extent that the water board deemed it advisable to increase this capacity to 350,000,000 gallons. This was accomplished in the fall of 1914 by raising the dam 30 inches and by the construction of an auxiliary concrete spillway 150 feet in length at a total cost of $4000. In raising the crest of the spillway, the top surface of the concrete weir was roughened by bush hammering. One-inch holes 18 inches in depth, spaced 6 inches apart and staggered, were drilled, and in these holes were placed $\frac{3}{4}$-inch square twisted rods extended from the bottom of the hole to 26 inches above the top of the old spillway. One-half inch horizontal rods, spaced 8 inches on centers were wired to the vertical rods. At each abutment the concrete was cut out to a depth of 6 inches in order to properly bind the new concrete to the old abutments. In joining the new work to the old a remarkably good joint was made and not the slightest leak can be observed at it.

The reason for the construction of the auxiliary spillway was the fact that if the dam was raised 30 inches without providing some method of reducing the height of flood water, a large area of farm land would be inundated at each flood period. This scheme for reducing the water height has proved very successful, as the extreme flood height since the raising of the dam has at no time reached the level that occurred before the construction of the auxiliary spillway.

The water is pumped from Paradise reservoir to the service reservoir by a 6-inch single-stage contrifugal pump direct-connected to a 50-horse power electric motor. The electric current is obtained from the local public service company. The maximum charge is 2.35 cents per kilowatt-hour with an average charge of 1.9 cents. The average cost of current used in pumping 1000 gallons against a total head of 130 feet is 1.2 cents.

The water rate ranges from 4 cents per 1000 gallons where the monthly consumption exceeds 16,000,000 gallons to 12 cents per 1000 gallons where the consumption does not exceed 100,000 gallons per month.

The plant is managed by a board of four members and usually comprises the most capable citizens. By the ordinance creating the board no city official is allowed to become a member except the mayor, who is ex-officio chairman. The citizens of Mattoon are very proud of this water system, especially those who participated in financing the original proposition. The water department now has a sinking fund containing about $35,000 derived solely from the profits accruing from the operation of the works. In addition to this, betterments and improvements have been made since 1908 amounting to about $30,000, all being paid from the earnings of the plant.

Prof. A. N. Talbot was consulting engineer and the author, the present superintendent, had charge of the construction.